Proposal
On
Lean Thinking in Hospital Management:
An Empirical Study

Proposal for Doctoral Degree

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INTRODUCTION:

Lean management principles have been used effectively in manufacturing companies for decades, particularly in Japan. The lean principles have been now successfully applied to the delivery of health care over the last few years .Lean thinking begins with driving out waste so that all work adds value and serves the customer's needs. Identifying value-added and non-value-added steps in every process is the beginning of the journey toward lean operations.

Influenced by the work of Womack (2003) and Jones, Lean in health care as "an organization's cultural commitment to applying the scientific method to designing, performing, and continuously improving the work delivered by teams of people, leading to measurably better value for patients and other stake holders."In order for lean principles to take root, hospital must first work to create an organizational culture that is receptive to lean thinking. The commitment to lean must start at the very top of the organization, and all staff should be involved in helping to redesign processes to improve flow and reduce waste.

The management philosophy of lean production methods has ties to other operational and quality-improvement models such as total quality management (TQM)/continuous quality improvement (CQI), developed by W. E. Deming, and Six Sigma, developed by Motorola and General Electric. Although there are several overlapping points philosophy and techniques, a feature *distinguishing lean from these other models is in its value stream approach to driving change and eliminating waste within the process of providing a product for the customer.* Lean is unique in its focus on the specification of value from the customer's perspective and on the identification and categorization of waste and its transformation to value using specific tools. *The lean approach encourages individuals within the organization (from top to bottom) "to learn to see" the flow of their product's process and thus to help to identify areas of waste, with the ultimate goal of creating a product with built-in quality with the least amount of waste. Both Six Sigma and TQM/CQI focus on the delivery of a high-quality product. Once a system has been studied and standardized, Six Sigma utilizes rigorous statistical and data measurements to drive quality improvements in product delivery.* (Kohn 2000)Total quality management/continuous

quality improvement en-gages the entire organization in delivering a high-quality product from the customer's standpoint by getting everyone in the organization involved in the continuous improvement effort.Lean thinking builds directly on the plan– do– check–act cycle of CQI but adds tools to identify and transform waste .

Although health care differs in many ways from manufacturing, there are also surprising similarities: Whether building a car or providing health care for a patient, workers must rely on multiple, complex processes to accomplish their tasks and provide value to the customer or patient. Waste — of money, time, supplies, or good will — decreases value.I firmly believe lean principles when applied rigorously and throughout an entire organization, can have a positive impact on productivity, cost, quality, and timely delivery of health care services.

Lean production is a novel approach to delivering high-quality and efficient care to patients, and I believe that the health care sector can anticipate the same high level of success that the manufacturing and service industries have achieved using this approach. Hospitalists are primed to take action in delivering care of greater quality with more efficiency by applying these new principles in the hospital setting.

There is compelling evidence in the literature that acute care based Lean and Six-Sigma healthcare process improvement programs yield significant operational and financial benefits. Lean manufacturing is a method that streamlines the flow of goods and services and eliminates waste. Six-Sigma applies rigorous statistical control methods to reduce variation in a given process or entire production line. Our current economic downturn and unbridled healthcare cost inflation make it all the more worthwhile for acute care facilities to eschew waste and clean-up their operations, The hypothesis of this research being undertaken is to demonstrate the application of Lean, Six-Sigma, or a combination of both methods yield significant operational efficiency benefits for tertiary care hospital. In addition, the research will provide insight as to where, in tertiary hospital, these programs appear to be most effective.

Variations in the healthcare delivery process cost lives and money. Healthcare is a not a product that one can return or request a refund for. The results of poor healthcare practices are final and irrevocable. A single bad experience can affect patient satisfaction and ultimately affect a provider's reputation within the physician community and patient market area. Why is there so much variation with patient care processes? Why is it safer to fly a commercial aircraft than to stay in an acute care facility hospital (Aircraft Crashes Records Office, 2007). Would we board planes knowing that airlines shared a similar safety record than our hospitals (referring to the

Institute of Medicine's report that hospitals kill 100,000 patients a year; Kohn, 2000). Is there a cost for such quality? Does it make sense to sacrifice profitability or operational sustainability in the quest for air travel type safety or efficiency?

Will Lean and Six Sigma methods help a typical hospital survive the narrowing margins between costs and reimbursements? The annual increases in healthcare costs necessitate that we find a way to cut wasteful processes and inefficient delivery . Lean Manufacturing and Six Sigma initiatives are poised to increase quality while potentially reducing cost, patient inconvenience, and risk. From a business perspective, organizations that have formalized Lean and Sigma cultures are set to gain significant competitive advantages over their peers (Walston,1999; Waxer, 2003).

Consistent manufacturing processes mean less rework. Efficient production equals lower overall cost. Quality improvements based on Six Sigma ensure that the computers in our vehicles will last a lifetime or that a recipient's pacemaker functions nearly flawlessly (Kim, 2006). Lean manufacturing is the very reason why nearly everyone has a personal mode of transportation in the United States. The extrapolation of the same in the resource limited settings in Indian context can help us to deliver affordable world class quality healthcare to the masses by unlocking the operational efficiency at your hospitals .The same readily applies to the delivery of healthcare services to the teeming masses in both private and public sector hospitals .

This study will concentrate on the impact of Lean and six sigma thinking on hospital operations and management strategies.

The lack of a precise and holistic approach as a composite model of six sigma and lean methodology for the entire hospital operations is lacking all over the globe and its relevance in the resource limited setting in Indian context is further limited our study intends to contribute and fill the gap which would lead to better understanding of hospital operations and would lead to informed decision making by the hospital management in a unified way . Their perception and decision making of complex hospital operations would be scientific and predictable so as to deliver world class quality care at affordable price besides unlocking operational efficiency with limited resources .

Background

With health care costs continuing to rise, a variety of process improvement methodologies have been proposed to address the reported inefficiencies in health care delivery. Lean production is one such method. The management philosophy and tools of lean production come from the manufacturing industry, where they were pioneered by Toyota Motor Corporation, which is viewed as the leader in utilizing these performance improvement methods. Lean has already enjoyed tremendous success in improving quality and efficiency in both the manufacturing and the service sector industries.

Health care systems have just begun to utilize lean methods, with reports of improvements just beginning to appear in the literature. I describe some of the basic philosophy and principles of lean production methods and how these concepts can be applied in the health care environment. I describe some of the early success stories and ongoing endeavors of lean production in various health care organizations. I believe the hospital is an ideal setting for use of the lean production method, which could significantly affect how health care is delivered to patients.

The following describes in detail the historical and foundational basis of both Lean and Six Sigma methods during the course of history and its evolution .

The concept called "lean management" or "lean thinking" is most commonly associated with Japanese manufacturing, particularly the Toyota Production System (TPS). Much of the TPS way of thinking is based on the work of quality guru W. Edwards Deming, who taught, among other things, that managers should stop depending on mass inspection to achieve quality and, instead, focus on improving the production process and building quality into the product in the first place.

Toyota is widely recognized as one of the most successful companies in the world. Its automobiles have consistently placed at or near the top of the quality and customer satisfaction rankings published by J.D. Power and Associates and *Consumer Reports*. Toyota constantly focuses on the safety and well-being of its employees and the quality of its cars through its relentless dedication to continuous improvement in everything it does. Toyota has recently become the world's number two auto manufacturer, and the company's net profit margin was more than 8 times that of the industry average.

How has Toyota been able to achieve such remarkable results in product quality, market share, and profit margins? Jeffrey Liker, in his book *The Toyota Way*, described the world-renowned Toyota production system as supported by 2 pillars: continuous improvement and respect for people. The end result is a learning organization that values employee contributions and continuously strives to produce products of higher quality at lower cost. Lean production is the generic term used to describe the principles and methods of the Toyota Production System. Lean production has been implemented to improve performance in a broad array of industries, from aerospace and aluminum refining to financial services and insurance. The philosophy of lean thinking, which is derived from the Toyota Production System, is rapidly gaining a following among health care leaders, with a number of hospitals and medical groups around the country adopting a version of lean production as their systematic approach to improving quality and efficiency. In the coming years, the application of lean principles and methods could have a transformational effect on how health care is delivered, with the potential for dramatic gains in quality, safety, efficiency, and appropriateness

So what is meant by "lean thinking"? Simply put, *lean means using less to do more.*

Lean thinking is not typically associated with health care, where waste — of time, money, supplies, and good will — is a common problem. But the principles of lean management can, in fact, work in health care in much the same way they do in other industries.

Lean Healthcare

Early 20th century thinkers such as Winslow Taylor and Elton Mayo believed that the scientific investigation of production processes could lead to greater efficiency. Henry Ford realized a dream to mass produce affordable quality transportation. As a 'Taylorist,' Ford believed that production could be controlled scientifically. His advances in rapid production line assembly significantly lowered the cost of each vehicle while maintaining quality. Practical applications of Taylor and Mayo's theories led to further research into quality outcomes in the 1930s and 40s and led to rapid advances in quality management methods such as Total Quality Management (Womack 2003; Zidel, 2006).

Japanese contribution to Quality :

Reeling from infrastructural devastation after World War II ended, the Japanese set to rebuild their country into a post-war industrial powerhouse (Japan was a convenient staging area for the Korean War). Their post-war industries wanted to capture the booming American market. In a remarkable turnaround from low quality manufacturing, they emerged as the leading purveyor of

reliable cars and electronics. In essence, the phrase 'made in Japan' became a symbol for quality since 70s. Walter Deming is credited with helping the Japanese implement statistical control process methods to manufacturing (Nogushi, 2005). Joseph Duran is responsible for leading Japanese management's indoctrination on quality methods (Juran, 2004). Deming and Juran's work in Japan ultimately fathered what is commonly known as modern day Lean and Six-Sigma quality improvement methods (Zidel, 2006). Fifty years ago, Taiichi Ohno, a Toyota engineer, was sent to the United States to study our manufacturing methods. Ohno's manufacturing quality assurance methods were, in part, inspired by the Ford Motor Company (Varkey, 2007). Concerned with keeping Toyota price-competitive while maintaining high quality, he sought to identify all wasted processes ('muda') in his entire production line (Ohno, 1988). His discoveries led him to create a lean manufacturing precursor known as the Toyota Production System or 'TPS.' Ohno designed his production system to eschew processes deemed wasteful or that provided little added value to the final product desired by the customer (Womack, 2003). He asked why would anyone add features or unnecessary manufacturing complications that will add no benefit to the bottom line or compel the customer to purchase those features. Lean concentrates on the seven areas of waste identified in early Toyota Production System. They are overproduction, underproduction, wasted inventory, rework or rejects, wasted motion, lag time to market, and handling inefficiencies (Varkey, 2007).

In healthcare, these translate to empty beds or operating rooms: wait time in emergency rooms or admitting; supplies going past their expiration dates; errors in dispensing pharmaceuticals; searching for patient charts or medical supplies; delays in bed assignments or operating room start times; and delays in transportation of patients, equipment and supplies. Reworking every step within a production and service delivery process into the best possible sequence leads to a smooth and continuous flow of goods and services. Ultimately, these goods and services are delivered when needed and exactly how they were requested. Smooth production flow reduces variation and rework in processes and thus reduces the cost of production. This is principally the reason why Toyota became the leading vehicle manufacturer in the world in terms of volume and quality (Black, 2008; Womack, 2003).

Lean Tools

Lean's diverse tool set reportedly produces rapidly deployable solutions that deliver immediate results. A typical Kaizen (Kai means 'change' and Zen means 'good') event will incorporate a multitude of methods to attack particular situations and complex problems. The most common tool used in the lean method is Value Stream Mapping or VSM (Black, 2008), in which a lean team (process owners and participants and lean practitioners) maps all aspects of a particular process by means of graphical interpretations of process inputs, outputs and throughputs, and flow ('Spaghetti Maps'). Typically, a snapshot of the current state exposes the root causes of bottlenecks and wasted steps. Selected workers involved in that process will brainstorm ideas for improvements.

The Lean team will then introduce those process improvements at a Kaizen workshop—a carefully controlled, rapid-action planning and change management event where proposed improvements are tested. The outcome of the Kaizen establishes the 'future state' of the process. A typical Kaizen event only lasts a week from start to finish as it is designed to yield quick achievable results (Varkey, 2007; Wennecke, 2008). Some of the other more common methods in the lean toolkit are '5S, Kanban, Poke Yoke, 5Whys, Takt Time, Standard Methods, and SMED'. '5S' stands for sort, straighten, scrub, standardize and sustain. One could easily visualize how a storage room could be transformed into an efficient supply point for a busy operation. The Kanban is a component of' Just-in-Time' delivery whereas a given supply or service item is always available to the extent that it is not over or undersupplied. The Kanban is literally a 'tickler' that alerts when a supply item is about to run out—resulting in work stoppage (Black, 2008). 'Poke Yoke' is a Japanese idiom that loosely translates into 'fool proofing.' The 'poke' technique examines the ways a given process or item could be misused or improperly applied. Poke Yoke re-engineers the process to prevent such events (Black; Shingo, 1989). Self retracting phlebotomy needles are an example of Poke Yoke engineering as it reduces the likeliness of accidental needle sticks. '5-Whys' is a root-cause analysis method that operated on the belief that five levels of inquiry will always lead to the root cause of a problem (Taiichi, 1988). 'Takt Time' addresses the maximum time it takes to produce an item or service. Identifying a proper span of time to deliver a service to a patient helps establish standards and manage workloads. 'Takt Time' is most useful for setting labor schedules according to production capabilities. Setting these benchmarks is essential to controlling a process and avoids common 'bottlenecks' that quash efficiency. 'Standard Methods' establish a strict process for delivering a particular service or item.

By following standards, all actors in a given process function and deliver in the identical way. Enforcing orderly rules and procedures ensures consistent processing of patients at the point of admission. In contrast with Six Sigma, standard methods attack process variation by establishing a standard method of production—enforcing specific steps. Six Sigma controls the process through statistical production results and thresholds. Lastly, 'SMED' or 'Single Minute Exchange of Die' refers to the ability to manufacture more than one component using the same machine and worker (Shingo). In a lab situation, this refers to the ability to run different tests using the same equipment or lab technician. Lean is highly effective for its simplicity but has limitations due to its lack of statistical rigor. This lack of rigor opens up the possibility that a given process may not be fully optimized or properly sustained over time (Watson, 2003). Lean is also a tool set used by Six-Sigma to address process flows and bottlenecks.

Six-Sigma

In the early 80s, Motorola researched and perfected methods to improve their manufacturing process for their telecommunication equipment through rigorous statistical analysis (Varkey, 2007). These were rooted in Deming's Total Quality Management (TQM) and process re-engineering methods of Juran (Barry, 2002). By the early 90s, Jack Welch, then GE's CEO, implemented Motorola's process methods to eliminate manufacturing variation and speed production. Welsh was so impressed with the results that he brought the methods to his clients (Slater, 1999). This process-oriented method is known today as Six-Sigma. 'Sigma' is a statistical unit reflecting the number of standard deviations a given process is from the normal (Gaussian) distribution (Benedetto, 2003a). Everything in Sigma revolves around how many defects are generated by a given process. The goal here is to achieve a level of quality six standard deviations from the norm. In mathematical terms, this would represent 3.4 defects per million opportunities (DPMO) or an error rate of99.9996%. Therefore, one could calculate the DPMO to figure out how far they are from virtual perfection and estimate the cost to approach such.

Six-Sigma Tools

The single most important method of Six-Sigma performance improvement programs is the DMAIC. Simple enough, the acronym defines the five phases associated with each letter: Define, Measure, Analyze, Improve and Control. The following aptly describes each phase and its particular importance to the whole process.

'Define' marks the first phase of the Six-Sigma process. Typically, the Six- Sigma leader or Black Belt (credentialed Six-Sigma practitioner) will assemble a team to define a problem or issues with a particular process. The team will assess factors that are critical to quality—from a customer's (or patient's) point of view delivering what is desired in a consistent manner. Process flow diagrams are a key deliverable as they reveal unintentional process failures that lead to poor quality and bottlenecks due to rework. The practitioner will then separate out the variables and identify process gaps and unproductive steps that impede proper production (De Feo,2005; Stamatis, 2004). 'Measure,' the second phase, involves collecting and verifying data generated by the process that is being examined. It requires that data be collected from multiple sources to determine the type and depth of the defects or errors (DPMO) in the process or system. Ultimately, the data is quantified into critical-to-quality (CTQ) attributes. The results are then charted to evaluate the reliability of the data and assess performance in a suspect process. Six-Sigma requires a high degree of data integrity. 'Garbage in equals garbage out'—hence, process improvement decisions depend on valid data that are properly represented for a given process.

One of the best methodologies used by Six-Sigma practitioners, 'Gage R&R' (Analysis of Variance that gauges the repeatability and reproducibility of given data) ensures confidence that processes are being adjusted and maintained in response to reliable data samples.

Method Differentiators

Six-Sigma is costlier, more complex, and cumbersome to implement than Lean. DMAIC (Six-Sigma) projects require long periods of preparation and significant dedicated resources to complete. Executive commitment to these projects is tantamount to a blind faith commitment—since the outcome is often unexpected (Benedetto, 2003 a). Six-Sigma methods offer a rigorously structured and analytical approach to solving quality issues within a process or an entire

organization. Lean offers a quicker but far less data intensive journey to an improved process. Six-Sigma focuses on defects and yields. Lean is principally concerned with time to production.

From a healthcare perspective, the union of Lean and Six-Sigma are significantly beneficial. What lean provides is rapid abatement of delivery bottlenecks and unnecessary motion in a given process. Sigma enforces a data centric rigor that yields to higher quality and better products. The trick is to know how much improvement to apply before it turns toxic to the bottom line (Gottfredson, 2005).

It is no coincidence that the successes of Lean and Six-Sigma process initiatives are application specific. The most obvious trend in the literature suggests that Lean based programs offer a 'bigger bang for the buck' than competing Six-Sigma endeavors. The differentiator is where each of the methods is applied. Complex processes such as pharmacy operations and patient discharge lend well to the complex requirements of Six-Sigma. Bottlenecks in Laboratory and surgical operations are more effectively handled with Lean methods. The literature also suggests that 'leaning' processes involving patients (and people), met or exceeded the program expenditures more often than Six-Sigma programs. In most cases, Lean delivered faster results and was quicker to market than Six-Sigma (American Society for Quality, 2005). The major differentiator was sustainability of results over a long period. Lean provided fewer methods of sustainability as reliable as Six-Sigma (Bakzewski, 2005). Six-Sigma process improvement (PI) projects pose a significant time and financial commitment for any organization. Therefore, it is imperative for executive management to fully support the program and continuously defend its budget. It is equally important to carefully analyze the potential cost versus benefits of each undertaking. For-profit operations are more likely to cut a complex PI program short due to the lack of an immediate payback—originating from improperly set expectations. The best recommendation to address the profit mongers is to lead with Lean and introduce Six-Sigma once confidence on a financial outcome is solidified. In the author's experience, lean delivers quicker results freeing up funds to apply Six-Sigma methods and build momentum for its permanent commitment to change. Lean and Six-Sigma are probably the most comprehensive methods available to combat diminishing margins in acute care settings hospitals . Pay for performance, Medicare reforms and the threat of a single pay or environment require facilities to eliminate waste at all levels to stave off financial extinction.

The following literature review and analysis clearly illustrates why both methods are so compelling in their respective acute care applications. The healthcare industry is on the cusp of radical change on the financing side that will decrease reimbursements. Organizations that do not improve care and eschew process waste at the same time will experience financial survival challenges.

The lack of a precise and holistic approach as a composite model of six sigma and lean methodology for the entire hospital operations is lacking all over the globe and its relevance in the resource limited setting in Indian context is further limited our study intends to contribute and fill the gap which would lead to better understanding of hospital operations and would lead to informed decision making by the hospital management in a unified way . Their perception and decision making of complex hospital operations would be scientific and predictable so as to deliver world class quality care at affordable price besides unlocking operational efficiency with limited resources .

LITERATURE REVIEW

The literature on Lean Six-Sigma is ripe with success stories displaying compelling financial returns and significant operational improvements. Grouping examples by specific area of improvement seemed appropriate in establishing depth and breadth, as well as invite program comparison from one example to the next.

The review is focused on the following major areas of improvement: Patient Discharge and Length of Stay; Emergency Department; Operating Room flow and Scheduling; Hospital Laboratory; Diagnostic Imaging (Radiology); Revenue Cycle; and Supply Chain Management.

Patient Discharge and Length of Stay Related Projects

Given the current reimbursement environment for private and Health Maintenance Organizations insured patients , hospitals must minimize inpatient length of stay to what is reimbursable. Inpatient room and board represent a significant revenue contribution. Most private insurance plans and government entitlement limit inpatient stays according to procedure, disease and acuity. It is the author's experience that well-managed inpatient cases are generally discharged just before reaching the maximum allowable length of stay. The margin between reimbursement and cost for an inpatient stay is narrow. Therefore, overstaying potentially produces a loss for the event.

The following articles illustrate how each facility reduced length of stay and improved clinical outcomes at the same time.

Van Den Heuvel (2006) provides a great example of the application of Six-Sigma in a discharge process. The project reduced the length of stay in the delivery room from 11.9 to 3.4 hours, yielding an annual savings of $68,000. By early 2002, Commonwealth Health Corporation had invested about $900,000 in Six-Sigma and realized improvements worth more than $2.5 million. A number of health care organizations have followed the example of Commonwealth and achieved even better results. For instance, Mount Carmel Health System, a three-hospital system in Columbus, Ohio, reported a financial return of $3.1 million; the Six-Sigma program at Thibodaux Regional Medical Center, a 149-bed hospital in Louisiana, reported are curring annual savings of more than $475,000 (Van den Heuvel, 2006).

Sharp Grossmont and Memorial Hospitals in suburban San Diego County,California improved the median time between orders and actual discharge by 20%by implementing Six-Sigma techniques. Their black belt practitioners dissected their entire discharge process including pre-discharge events. By anticipating a patient discharge, the case managers would be prepared with their checklist and paperwork in hand. Having preliminary discharge discussions with the patient and family also cut down on the time to transfer care to the patient or the skilled nursing facility. Durable equipment, prescription orders and aftercare are now planned from several days to just the day before the discharge. Therefore, patients were confident that their care was adequately planned for. Reducing the length of stay was the principle benefit as it increased profitability per discharge and increased bed availability in busy units (Atkins, 2006).

Mayday Hospital in London UK applied lean thinking to the hospital discharge process. This initiative reduced the length of stay for the average patient by 25%. Mayday was able to close 78 beds and reduce related operation expenses while still maintaining original service levels and capability. By analyzing complexity and length of stay in conjunction with care flow, they created a process that is customized for each medical condition. The results standardized care and discharge procedures across a wide swath of patients (Mathieson, 2006).

Park Nicollet Medical Center, a 426-bed hospital in Minneapolis, Minnesota, implemented lean healthcare methods to address operation issues and patient satisfaction. Their efforts decreased patient wait time, allowing the center's new ambulatory clinic to reduce the number of examination rooms. Prior to implementing lean, patients were scheduled in batches - leading to increased wait times and patient satisfaction issues. The leaned out process allowed continuous patient scheduling—'continuous flow' as it is formally known. Appointments were set at 10-minute intervals allowing for proper sequencing of screening, physician consultation and diagnostic testing procedures (Varkey, 2007).

Caldwell and Van Den Heuvel are prolific writers on Lean and Six-Sigma process improvement programs. They have written and collaborated on dozens of articles and industry presentations that inspired many healthcare executives to sponsor the above programs. They emphasize that efficient and timely patient discharge can greatly improve the bottom line of acute care facilities. Given the current DRG based reimbursement climate and new regulations governing complications and MSDRG, discharge mishaps can have significant effects on the bottom line, up to, and including the long-term financial viability of a hospital.

Operating Room Flow and Scheduling

Bay Medical Center (a 413-bed regional acute care hospital in Panama City, Florida) saved $2 million over the course of 18 months by implementing Six-Sigma across the facility. The primary area of improvement was pre-surgical readiness - whereas reductions in cancelled and rescheduled surgeries save $1.2 million. Reworking the authorization, precertification and pre-operative workflow reduced waste, cancellation and authorization penalties (Hagland, 2006).

Southwestern Vermont Medical Center (SVMC), a 99-bed hospital located in Bennington, Vermont, increased on time OR start times by 500% through the implementation of Six-Sigma processes. Prior to the project, only 12% of surgeries started on time. Post project, less than 11% of surgeries started late. Turn around time for the OR suites improved by 20% representing a decrease in 6 minutes per case. The on time starts and improved turnaround increase OR capacity and decrease overtime expenditures. Following this success, SVMC analyzed its entire revenue cycle—discovering that observation patients were often misclassified. Reworking the admission process corrected the problem—increasing revenue by $780,000 (Fairbanks, 2007).

Emergency Department

For many hospitals, a good portion of admits are sourced from emergency departments (ED). However, throughout the United States and especially in California, a growing number of hospitals have closed their EDs. The increasing reliance on fewer EDs results in crowded and often chaotic conditions that present a major threat to a facility's financial security.

The following articles demonstrate the impact of lean and Six Sigma methods on ED flow and length of stay.

Columbus Regional Hospital (a 325-bed facility located in Columbus, Indiana) implemented Lean and Six-Sigma across the hospital. The most notable application, Lean, resulted in reduced lengths of stay in the emergency department. The application of 5S and standardization of care resulting in an LOS reduction by acuity levels, between 26% and 38%~patient leaving without being seen decreased by 75%. The financial impact of this single project was an $800,000 annual increase in revenue (Charles, 2008).

Virginia Mason Medical Center (a 336-bed general hospital located in Seattle, Washington) increased profitability in its clinical operations by improving the patient flow throughout the

entire ED length of stay. Applying Lean Six-Sigma to patient centric processes increased visit capacity and patient satisfaction by reducing patient wait time. The result of this single isolated project increased profits by $310,000 (Neurath, 2008).

In 2006, Floyd Medical Center (a 304-Bed hospital located in Georgia) adopted Lean Six-Sigma as their performance improvement initiative. During its first five 100-day workout, FMC increased 80% of their discharge by 2PM, had a 60-minute bed turnover rate, ED length of stay decreased to less than 4 hours and idle staff in the OR was reduced by 40%. Their 100-day workouts consisted of a combination of Kaizen and DMAIC events applied to specific problem areas such as patient discharge, OR queuing, admissions and length of stay. FMC realized $6.3 million in annualized savings that translated into a 2.5% net increase in revenue (Caldwell, 2006; Caldwell, 2008).

Hospital Laboratory

Much like Diagnostic Imaging, a hospital cannot function without a clinical laboratory. Although the majority of laboratory work ordered for inpatient receives little reimbursement, there is ample opportunity to address operational costs and efficiencies.

The following examples illustrate targeted improvement programs and investment returns on those improvements.

The Nebraska Medical Center, a 689-bed tertiary/quaternary care hospital, applied combined Lean and Six-Sigma methods across its facility. Their clinical laboratory Kaizen project reduced core space by 825 square feet and eliminated 11 full-time equivalents (FTE). Managing cost and flow of the hospital's supply chain yielded $750,000 in increased revenue per year—without a single layoff. Reengineering facility-wide communication with 'Crew Resource Management' eliminated delays in admission, transportation, discharge and procedure starts. Financially speaking, NMC increased its net revenue by 700%. Day's cash on hand increased from 10 days May 2003 to 100 days in September 2006. Average length of stay (LOS) decreased 10% from 6.29 to 5.72 days over a 5-year period reflecting the increases in net income reported above (Fosdick, 2007).

Dr. Gary Kaplan, CEO of Virginia Mason Medical Center, reports that implementing lean throughout the hospital increase revenue by more than $24 Million. The hospital's employees walk less and spend less time searching for equipment. They slashed capital spending by $11

million by using space more efficiently (5S rework). Departments such as the medical laboratory shaved their report response time by 85% through the elimination of unnecessary steps and paperwork (Mc Auliffe 2004; Neurath, 2008).

Diagnostic Imaging

Diagnostic Imaging is a significant revenue center in any hospital operation. Due to the variety of procedures ranging from non-invasive to minimally invasive, there are ample opportunities to introduce waste and inefficiency. A good portion of the literature on Lean and Six-Sigma projects cover significant applications of the methods and present positive trends in expected outcome.

The following examples detail how such methods achieved sustainable results.

MD Anderson employed Six-Sigma to streamline its CT diagnosis process. Prior to project, 207 CT examinations on 115 patients were performed in 16 hours. At the completion of the Sigma project, the center was performing 300 CT examinations on 160 patients using the same resources. Much of the improvements addressed bottlenecks before a patient has the diagnostic procedure performed. Pre-Sigma, a patient waited as much as an hour. Post-Sigma the wait was reduced down to 4.5 minutes. By plotting the process from admission to report transcription, the team discovered that the technologists would handle nearly the entire process post admission to the actual study capture. Assigning nurses' assistants to help position the patient on the CT, and having clerks handled all the paper work, allowed the technologist to run patients through in half the time. Other changes in the process were a rework of archived film for quick retrieval and having clerks hang the film for the radiologists. In all, the entire process is 50% more efficient—translating into a 50% increase in revenue and greater output per unit of labor (Elsberry, 2000).

Stanford Medical Center (a 613-bed tertiary/quaternary care hospital located in Palo Alto) engaged GE Medical Systems to implement Six-Sigma process improvement in their diagnostic imaging department. The focus of the project was to increase throughput and decrease outpatient scheduling backlogs. A careful analysis of the schedule and productivity revealed that the center lost at least 35 studies a day due to inefficient operations. In addition, no shows added to lost revenue and contributed to the scheduling backlog. A redesign of the entire scheduling and pre-registration process increased capacity by 75% and created an additional $1.5 million in revenue (Loree, 2003).

Revenue Cycle

The complexities posed by a multi-payor system in the United States and as well as in India provide many opportunities to tighten-up the revenue cycle process. Much like assembling a car, revenue cycle encompasses many processes that begin at the point of admission though remittance and collections. Due to the sheer number of actor and processes involved, it is easy to introduce inefficiencies into each separate process that encompass the revenue cycle. A mere delay in completing and signing charts can delay reimbursements and possibly result in financial penalties or denials. Since hospital margins are typically thin, the slightest ripple in the process generates significant peaks and valleys in cash flow.

The following examples highlight the efficacy of Lean and Six-Sigma performance improvement projects designed to increase and accelerate revenue collection.

'ThedaCare' (a Multi-Hospital system with 27 clinics and a health plan serving 300,000 members) set up event weeks where employees trained on lean management techniques. The events, much like a kaizen, were designed to instill lean principles throughout the organization. They increased cash flow by removing the bottlenecks out of their revenue cycle using value stream mapping. The result of this project alone decreased days in accounts receivable by 12 days and increasedcash flow by $12 million. ThedaCare's momentum with lean yielded another $3.4 million in operational improvements by reworking patient flow and decreasing procedure time throughout their organization. Appleton medical center, a sister facility, reduced their medication distribution time by 50%~thereby saving another 4 full-time equivalents (Miller, 2005).

Supply Chain Management and Standardization

Supply chain management bears a direct impact on operation efficiency and profitability. Healthcare experiences identical challenges further compounded by regulatory and safety requirements. It is not surprising that well run hospitals exhibit excellent control over their supply chain.

The following examples demonstrate successful Lean and Six-Sigma program outcomes.

Toronto Hospital for Sick Children (a 400-bed pediatric facility) commenced its lean program by addressing supply chain issues with its interventional radiology procedures. The department performed approximately 2,500 procedures per year. Prior to applying lean methods, supplies

would go out of stock—requiring purchase on the spot market—a process that significantly increased the cost of each encounter. A simple analysis of its historical usage of supplies for the procedures set a trend in the ordering process and revealed areas of waste. The analysis helped set new upper and lower control limits on its inventory. Under the new control parameters, the hospital eliminated overbought, expired supplies, and reduced unneeded inventory They controlled last minute ordering and increased the supply-chain forecasting accuracy. In a four-year span, the cost center saved $140,000 (Rosen 2004).

RATIONALE OF STUDY

The literature review suggests that the application of Lean and Six-Sigma based performance improvement methods bear positive financial and operational benefits. A deeper investigation reveals return on investment differentials between Lean and Six-Sigma programs. The same holds true for particular applications of either method applied to different acute care cost/revenue centers.

Research gap and need for the study:

The lack of a precise and holistic approach as a composite model of six sigma and lean methodology for the entire hospital operations is lacking all over the globe and its relevance in the resource limited setting in Indian context is further limited our study intends to contribute and fill the gap which would lead to better understanding of hospital operations and would lead to informed decision making by the hospital management in a unified way . Their perception and decision making of complex hospital operations would be scientific and predictable so as to deliver world class quality care at affordable price besides unlocking operational efficiency with limited resources .

With increasing corporatization of health and hospital sector , financial viability and sustainability is the order of the day also the government sector hospitals struggling for funds and their accountability , operational efficiency need to be derived . The utilization of these funds is entrusted with the state government medical officers who are ill equipped and inadequately trained .

The study will be conducted in phases

- Identifying the existing hospital operation activities (AS IS –SOP)
- Gaps in key hospital activities and operations
- TO –BE management policies in the major areas of hospital departments

- Arrive at the sigma levels and further discriminate those with the statistical tools like regression analysis ,discrete analysis , CFA etc to finally arrive at a composite healthy hospital index (HHI and will suggest strategies for increasing the operational efficiency)

The study is likely to benefit the hospital administrators in fine tuning the management practices.

As India in the next millennium shifts to a care quality culture (as opposed to a fiscally managed care culture of the government), the defects limiting nature of Six-Sigma programs in health will take on more significance. Eliminating defects and inefficiencies in the delivery of healthcare will eventually lead to a healthier population. We will achieve such at a lower cost with greater consistency, quality and safety. The investments we make in cultural quality transformations, such as Lean and Six-Sigma, will pay significant dividends in the next decade and become second nature. It has happened throughout the industrial continuum. It is now taking hold in the delivery and production of healthcare services. by reducing defects, enhancing customer service and generally lowering costs across the board and want to be torch bearer of the same .

RESEARCH METHODOLOGY:

Background

The literature research focused on major initiatives taken to improve hospital operations and management tools applied including hospital-based Lean, Six-Sigma (LSS) and combined approach performance improvement programs being practiced and conducted all over the world including India in the United States, with additional examples from the united States the Netherlands and the United Kingdom.

At first glance, assessing financial or operational benefit for these programs appeared difficult at best, since most acute care organizations and hospitals rarely share specific financial data also the LSS is still infancy in the country.

Research Approach:

The study on hospital operations is empirical in nature and quasi experimental exploratory would be limited to Fortis Escorts hospital Jaipur, a tertiary level multi-specialty hospital considering the paucity of Indian hospitals implementing structured hospital operation including Six sigma or Lean six sigma (LSS) , in addition the challenges in the hospital processes with collecting the specific data on implementation of hospital operations.

Phase 1: Analysis of peer-reviewed literature with a meta-analysis of data available

Phase 2: As – Is, SOP of various hospital operation

Phase 3: Pre sigma activity analysis

Phase 4 Post training sensitization activity analysis (Intervention Phase)

Phase 5: Application of LSS /PCA/RA

Phase 6: TO –BE Hospital operations

Phase 7: Healthy Hospital Index (HHI)

Research Design :

The study will be conducted in phases identifying the existing hospital operation activities (AS IS –SOP) , gaps in major hospital activities , TO –BE management policies in the major areas of hospital departments , arrive at the sigma levels and further discriminate those with the statistical tools like regression analysis ,discrete analysis , CFA etc to finally arrive at a composite healthy hospital index (HHI) and will suggest strategies for increasing the operational efficiency . The study is likely to benefit the hospital administrators in fine tuning the management practices.

The first phase of the study a description of existing hospital operations and core areas all over the world followed by AS- IS –SOP at Fortis Hospital .Identification of performance index KPI , KPR key person responsible. The description will be obtained through a review of existing literature and current prevailing best practices in the hospitals. Analysis of core functional areas will give us a clear view of current situation and ground realities in hospital operations .This would be followed by phase of sensitization of asset owners and leaders (FOS –AO) of the activity .The review of subsequent data and application of statistical tools would be final phase of the study . A detailted study of hospital operation activity flow would be carried out to establish and arrive at index. The major component of lean and six sigma management strategies will be identified in the process.

Sampling Technique

Purposive sampling entails the selection of the most readily available processes Purposive sampling technique was used to select the sample because of the limited amount of time and availability of the established and documented hospital processes .

Sample selection Criteria

Inclusion criteria

Hospital processes and Fortis Operating system (FOS Score card)

Exclusion criteria

Hospital processes which did not have defined SOP and in which the processes involvement is minimum.

Data analysis :

The Pre test values (AS –IS –SOP) are obtained from the hospital processes mean and standard deviation were obtained. Sigma values are obtained by arranging the observed values and tolerance level obtained Cp values were obtained using the formula Cp=(Upper Limit – Lower Limit)/ 6 Multipled by Standard deviation will yield Cp and compared to the table values for Six Sigma.

The aim of the project is to analyze the existing Hospital Operating system at Fortis Escorts hospital, Jaipur and to find out the efficacy of sigma tool to ascertain and improve the performance to drive in operational efficiencies.

PRIMARY OBJECTIVES:

1. To study and analyze the existing hospital operations
2. To develop , measure and analyze the baseline benchmark tools for Hospital Operations.
3. To identify gaps , waste in hospital operations

SECONDARY OBJECTIVES:

1. To develop a composite healthy hospital index (HHI)

Scope of Study:

It is about engaging in a disciplined data collection on hospital operations and analysis to determine the best possible ways of meeting customer needs while satisfying the organization and minimized waste resources and maximizing profit in the process.
The scope of the research is to analyze the operations and using the specific intervention like six sigma , lean to quantify and improve the same .

The sources and tools for Data collection

The study will be based on both primary and secondary sources

Primary data sources

- Registers kept at various departments
- Personal interviews of Assets lead owners
- FOS TRACKING LAN Network

Quasi Experimental Study conducted at Fortis Escorts Hospital, Jaipur. The hospital is having a hospital operations programme – Fortis Operating System.(FOS) .The FOS analysis more then 120 parameters analyzed on daily basis. The report is then generated as weekly score card. The method of six sigma DMAIC- Define, Measure, Analyze, improve and Control will be used as process control

Secondary Sources:

Literature Review will be based on previous research, published reports of various tools of hospital operations who are in the process or implemented six sigma and lean methodology government agencies, International research organization , nonprofit agencies , think tanks and other established agencies.Appropriate analytical and statistical tools will be applied for data analysis.

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